Sleep Medicine 15 (2014) 918–922

Contents lists available at ScienceDirect

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep

Original Article

Metacognitive beliefs relate specifically to sleep quality in primary insomnia: a pilot study

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ARTICLE INFO

Article history:
Received 3 December 2013
Received in revised form 15 March 2014
Accepted 17 March 2014
Available online 9 May 2014

Keywords:
Cognitive behavioral therapy
Insomnia
Intrusive negative thoughts
Metacognitive beliefs
Model of primary insomnia
Poor sleep quality

ABSTRACT

Objective: To identify whether metacognitive aspects are a specific mental pattern of primary insomnia (PI) or an aspecific correlate of sleep alterations.
Methods: Sleep quality (Pittsburgh Sleep Quality Index: PSQI), anxiety (Self-rating Anxiety State: SAS), depression (Beck Depression Inventory: BDI) and metacognition (Metacognitions Questionnaire – Insomnia: MCQ-I) were evaluated in 24 PI patients, 13 snorers and 17 healthy controls. Rank-transformed PSQI, BDI, SAS and MCQ-I scores were submitted to one-way analysis of variance with group as a between-factor. PSQI was submitted to three-way analysis of covariance (ANCOVA) with MCQ-I, BDI or SAS as covariate and group as a between-factor. Post-hoc analyses were conducted using pairwise comparisons with Sidak correction.
Results: As expected, PSQI scores significantly differentiated the three groups, one from another: PI had highest scores followed by snorers and healthy controls. PI subjects had MCQ-I scores significantly higher than those of snorers and healthy controls; no difference between the latter groups was found. The ANCOVA on PSQI with MCQ-I as a covariate abolished the difference in sleep quality between PI and snorers, whereas covarying for BDI or SAS left the differences in sleep quality between the groups unchanged.
Conclusion: These preliminary results lead to two main conclusions: (i) metacognitive aspects are more prominent in PI when compared to snorers and healthy controls; (ii) MCQI shows higher sensitivity in defining PI patients, with respect to PSQI. If these findings are confirmed and expanded by further studies, the development of a specific metacognitive model of primary insomnia may be warranted.

1. Introduction

Insomnia is a highly prevalent health problem worldwide. Among insomnia patients, 25–30% suffer from primary insomnia (PI) [1,2], which is characterized by difficulties in initiating and/or maintaining sleep, in the absence of psychiatric or medical causes. Fatigue, cognitive impairments and poor motivation with a negative impact on personal, professional, and social functioning are commonly reported and attributed to disturbed night-time sleep [1]. In addition, the chronic alteration of homeostatic properties of sleep in PI makes this sleep disorder a long-lasting stressor *per se*, which alters emotional processing [3,4] and increases the vulnerability for developing depression [5,6] and other somatic diseases [7,8].

It is widely accepted that intrusive, uncontrollable and negative thoughts at bedtime characterize PI patients [9–15]. In addition, maladaptive strategies (ie, metacognitive beliefs including attitudes, expectations and attributions) of thought control in PI patients may fuel further intrusions, generating a vicious cycle which impairs the ability to initiate and maintain sleep [14,15] and potentially modulates chronicity [14–16].

It is well known that cognitive processes play a key role in managing emotions, and hence in modulating physiological arousal and

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http://dx.doi.org/10.1016/j.sleep.2014.03.017
1389-9457/

behavioral output [10,11,13]. In this context, there is considerable evidence for the efficacy of cognitive behavioral therapy in ameliorating primary insomnia [17–21]. The existing cognitive and behavioral models of insomnia have been recently reviewed by Ong et al. [22], who proposed a novel two-level model of insomnia based on cognitive (primary) and metacognitive (secondary) arousal.

However, the specific nature of the link between metacognitive beliefs and PI needs further clarification. At present, it is not clear whether metacognitive beliefs are exclusively related to PI or are common to all conditions of disturbed sleep.

Herein we investigate whether metacognitive beliefs are pathognomonic symptoms of primary insomnia or are aspecifically related to poor sleep quality. As proposed by Waine et al. [23], snorers have been chosen as control subjects for poor sleep quality since they are devoid of any relevant psychopathological confounding factor, contrary for example to patients with obstructive sleep apnea syndrome [24].

2. Methods

2.1. Selection of subjects and administration of psychometric questionnaires

From January 2012 to December 2012, 24 outpatients (14 females and 10 males, mean age 53 years) attending the Sleep Center of the Clinical Psychology and Psychiatry Units, University of Pisa, Italy, who met diagnostic criteria for PI according to DSM-IV-TR [1] were recruited. Inclusion criteria [1] were: difficulty in initiating and/or maintaining sleep or non-restorative sleep, with at least one associated daytime impairment, for at least one month; absence of any sleep disruptive medical/psychiatric condition and substance abuse; and/or absence of other sleep disorder. The study enrolled only individuals with PI complaining of sleep difficulties for at least three nights per week.

Exclusion criteria were: cognitive decline, previous or present diagnosis of psychiatric disorders, obstructive sleep apnea syndrome (OSAS), restless legs syndrome or other sleep disorders.

Two control groups were enrolled in the study: 17 healthy subjects (nine females and eight males, mean age 50 years) and 13 snorers (seven females and six males, mean age 54 years).

No participants (including PI patients) met the DSM-IV-TR criteria for depression or anxiety [1], nor were receiving any pharmacological and/or psychological treatment as verified by medical examination conducted by a clinical psychiatrist (L.P.). Normal-sleeping participants met research diagnostic criteria for normal sleepers according to Edinger et al. [25].

Snorers were subclinical hypertensive patients complaining of poor sleep quality due to snoring but without signs of OSAS. The lack of OSAS was assessed by a sleep medicine specialist according to the guidelines of the International Classification of Sleep Disorders, second edition [26]:

> (A) The patient has a complaint of excessive sleepiness or insomnia. Occasionally, the patient may be unaware of clinical features that are observed by others.

Regarding this point, all snorers had complaints of poor sleep, but not of insomnia.

> (B) Frequent episodes of obstructed breathing occur during sleep.

None of the patients in the snorers group (nor their roommates) reported episodes of obstructed breathing occurring during sleep.

Criterion A was partially met whereas criterion B was not met for any of the snorers, and since the minimum condition for a diagnosis of OSAS is the simultaneous presence of criteria A, B and C, diagnosis of OSAS was excluded. As a further confirmation, all snorers underwent all-night O_2 saturation monitoring. Snorers were not pharmacologically treated for hypertension but they all followed a sodium-restricted diet.

The study conformed to the Declaration of Helsinki and was approved by the local ethics committee. All patients provided written informed consent prior to entering the study.

The selected subjects underwent a face-to-face evaluation conducted by a sleep medicine specialist concerning sleep quality, anxiety levels, depressive status and metacognitive beliefs. Sleep quality was evaluated through the administration of the Pittsburgh Sleep Quality Index (PSQI [27]): scores > 5 on PSQI reliably identify clinically significant sleep disturbances [27].

Depressive status was assessed using the Beck Depression Inventory (BDI): the presence of depressive symptoms is defined by BDI scores > 10 [28]. Anxiety levels were assessed with the Self-rating Anxiety Scale (SAS): the presence of clinically relevant anxiety symptoms is defined by SAS scores > 44 [29].

Metacognitive beliefs were evaluated using the Metacognitions Questionnaire –Insomnia (MCQ-I) whose discriminant validity, scale sensitivity and specificity have been demonstrated [23]. The MCQ-I is a questionnaire with 60 items answered using a scale ranging from 1 ('I do not agree') to 4 ('I totally agree'). The questionnaire evaluates beliefs concerning the meaning of the intrusions (eg, 'Thinking in bed prevents me getting to sleep') and plans that guide and shape the form that cognition takes (eg, 'Before I fall asleep, I should try and switch off my thoughts').

The snorer group was specifically selected to test the hypothesis: is strong endorsement of metacognitive beliefs a distinctive feature of PI, or more generally related to poor sleep quality? In the former scenario, poor sleep quality of snorers would not be paralleled by higher MCQ-I scores relative to healthy controls. In the latter case, snorers would have both PSQI and MCQ-I levels halfway between PI patients and healthy controls.

2.2. Statistical analyses

All variables (with the exception of gender) were tested for normality (Shapiro–Wilk test [30]). Variables with non-normal distributions were rank-transformed prior to any further test [31]. As a first step, groups (PI, primary insomnia; S, snorers; C, healthy controls) were checked for gender and age differences. Gender differences were assessed using the χ^2-test, whereas age differences were assessed using one-way analysis of variance (ANOVA) with group as a between-factor.

Scores related to PSQI, BDI, SAS and MCQ-I were rank-transformed and submitted to one-way ANOVA with group as a between-factor [31]. Whenever a significant group-effect was found, post-hoc analyses were conducted using *t*-tests with Sidak correction for multiple comparisons [32].

Putative dependencies of sleep quality differences between the three groups on either metacognitive beliefs (MCQ-I), depression (BDI) or anxiety levels (SAS) were assessed using analysis of covariance (ANCOVA) on ranks [33], with group as a between-factor and MCQ-I, BDI or SAS as a covariate.

The ANCOVA model was chosen as it enables evaluation of whether the means of groups of a dependent variable (PSQI) are equal across levels of a categorical independent variable (group, PI, S and C in our case), while controlling for the effects of another variable (the covariate, MCQ-I, BDI or SAS). Therefore, when performing the ANCOVA, PSQI means are adjusted to what they would be if all groups were equal on the covariate. Whenever a significant group-effect was found, post-hoc analyses on marginal means

were conducted using pairwise comparisons with Sidak correction for multiple comparisons [32].

3. Results

No group differences were observed for gender ($P < 0.93$) or age ($P < 0.63$), whereas significant group-effects were found for all psychometric tests (Table 1, Fig. 1). On the basis of post-hoc analyses, PSQI scores of PI patients were significantly higher than those of both snorers and healthy controls. Snorers had PSQI scores significantly higher than those of healthy subjects (Table 1, Fig. 1).

As far as metacognitive aspects are concerned, PI patients showed MCQ-I scores significantly higher than those of snorers and healthy controls (Table 1, Fig. 1), whereas no significant difference was found between snorers and controls.

Interestingly, despite the presence of poor sleep quality as indicated by PSQI scores in snorers, MCQ-I scores did not differentiate snorers from healthy controls. The same holds also for both BDI and SAS: for both questionnaires the scores of PI patients were significantly higher than those of snorers and healthy controls (BDI of PI patients was slightly above the threshold for depressive symptoms) whereas no significant difference was found between the latter groups (Table 1, Fig. 1).

As a second step, in order to verify whether metacognitive beliefs are a specific feature of PI or are aspecifically related to poor sleep quality, PSQI was submitted to ANCOVA with MCQ-I as covariate. As a countercheck of the specificity of MCQ-I effects, we verified whether the inclusion in the model of either anxiety or depression levels (even if sub-threshold) significantly attenuated differences between groups. Therefore PSQI was submitted to two-way ANCOVA with SAS or BDI as covariates.

A significant group-effect was found for all the three ANCOVA models (Table 2); however, whereas the effect of the covariate was non-significant for SAS and BDI scores, a tendency towards significance was found for MCQ-I ($P < 0.09$). The inclusion of MCQ-I as a covariate led to the suppression of differences in sleep quality between PI and snorers (Table 2, Fig. 2). On the contrary, the inclusion in the model of either SAS or BDI did not modify pairwise comparisons among groups with respect to the one-way ANOVA model. In both cases all three groups were significantly different from one another (see Fig. 2).

4. Discussion

This study investigated whether metacognitive beliefs selectively represent the clinical picture of primary insomnia (PI) or are aspecifically related to poor sleep quality.

To this aim we studied a sample of PI patients compared to subjects with poor sleep quality due to snoring and healthy controls by evaluating sleep quality (PSQI), depressive status (BDI), anxiety levels (SAS), and metacognitive beliefs (MCQ-I). Despite the relatively small number of PI patients included in the study, our data confirm previous results in this population of patients [23].

It is fair to underline, as a limitation of the study, that the three groups (PI, S and C) were not perfectly balanced in terms of gender composition (the percentages of women were 58%, 54%, and 53% for PI, S and C, respectively), although the difference in gender composition was non-significant ($P < 0.934$).

Analysis of variance confirmed that PI patients had poorer sleep quality (PSQI scores) when compared to snorers ($P < 0.0001$) and healthy controls ($P < 0.0001$); snorers in turn had poorer sleep quality when compared to healthy controls ($P < 0.0001$).

Metacognitive beliefs, anxiety and depression levels were significantly higher in PI patients when compared both to snorers and healthy controls, indicating (for PI patients) links with poorer sleep quality. Even though SAS scores were higher in PI patients relative to the other two groups, scores were still below the cut-off for pathological anxiety levels. With respect to depressive symptomatology, BDI scores for the PI group were slightly above the cut-off (mean score 12 ± 3), which was an expected result since PI and depression are mutually linked [4,5]. As previously documented [23], metacognitive beliefs were high for PI patients. From a clinical standpoint, these results raise the following question: could metacognitive beliefs, anxiety levels and depressive status play a role in triggering and/or maintaining PI?

For elucidating this issue we have tested the weight of metacognitive aspects, anxiety and depression in influencing sleep quality across all groups. ANCOVA indicated that lower sleep quality in PI patients was paralleled by higher MCQ-I scores: when investigating group differences in PSQI scores controlling for MCQ-I values: (i) the significant difference in sleep quality between PI patients and snorers disappeared; (ii) the difference in sleep quality between PI and healthy controls was less significant ($P < 0.001$) than the difference found in the simple ANOVA model ($P < 0.0001$); (iii) and the difference between snorers and healthy subjects was unaltered by the inclusion of MCQ-I as a covariate in the model ($P < 0.0001$) (Tables 1 and 2).

On the contrary, the inclusion of anxiety or depression in the ANCOVA model left the sleep quality differences between the three groups unaltered, ie, comparable to those found in the ANOVA with no covariate.

These data confirm that, in PI, metacognitive beliefs are an important feature of a complex clinical picture in which other ancillary factors, such as stress and depression, could play a role. Indeed, mental activity of PI patients during the night is mainly devoted to generate thought-control strategies, including reappraisal, worry, and thought suppression. These strategies, in turn, may induce a vicious cycle, maintaining insomnia. One possible explanatory model, which has been previously hypothesized [23],

Table 1
Descriptive statistics for the primary insomnia patients (PI), snorers (S), and healthy controls (C).

Parameter	Mean ± SE			ANOVA		Pairwise comparisons		
	PI	S	C	F_{group}	P_{group}	PI vs S	PI vs C	C vs S
Age	53 ± 3	54 ± 3	50 ± 5	0.46	<0.63	–	–	–
PSQI	15 ± 1	10 ± 1	2 ± 1	71.28	<0.0001	PI > S, $P < 0.0001$	PI > C, $P < 0.0001$	S > C, $P < 0.0001$
SAS	41 ± 2	36 ± 1	36 ± 1	10.96	<0.0001	PI > S, $P < 0.005$	PI > C, $P < 0.001$	–
BDI	12 ± 3	2 ± 1	1 ± 1	31.30	<0.0001	PI > S, $P < 0.0001$	PI > C, $P < 0.0001$	–
MCQ-I	122 ± 7	66 ± 2	61 ± 1	86.06	<0.0001	PI > S, $P < 0.0001$	PI > C, $P < 0.0001$	–

ANOVA, analysis of variance; PSQI, Pittsburgh Sleep Quality Index; SAS, Self-rating Anxiety Scale; BDI, Beck Depression Inventory; MCQ-I, Metacognitions Questionnaire – Insomnia.
F-value and significance of group-effect are shown for each parameter (ANOVA with group as a between-effect). For parameters showing a significant group-effect, significant pairwise comparisons are shown, along with the direction of the comparison. *P*-values <0.0001 are saturated to 0.0001 for visualization purposes. For all parameters with the exception of age, ANOVA was performed on rank-transformed values.

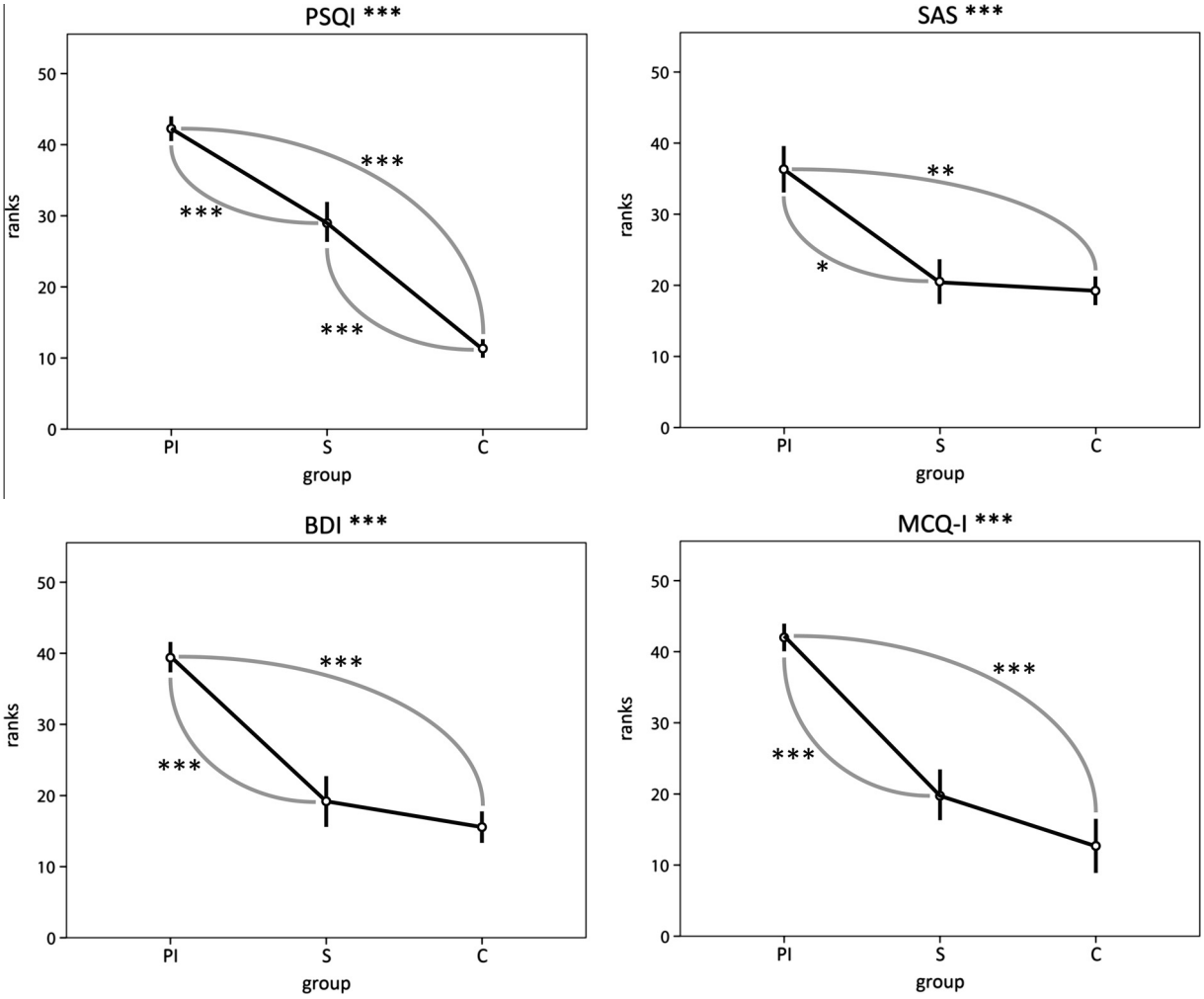

Fig. 1. Analysis of variance with group (PI, primary insomnia patients; S, snorers; C, healthy controls) as a between-factor for Pittsburgh Sleep Quality Index (PSQI), Self-rating Anxiety State (SAS), Beck Depression Inventory (BDI) and Metacognitions Questionnaire – Insomnia (MCQ-I), performed on rank-transformed scores. In each panel and for each group, values are presented as mean ± standard error. For each panel, significant pairwise comparisons are denoted by grey arcs. $^{*}P < 0.005$, $^{**}P < 0.001$, $^{***}P < 0.0001$.

Table 2
Results of analysis of covariance on PSQI with SAS, BDI or MCQ-I as covariate.

Model	ANCOVA				Pairwise comparisons		
	F_{group}	P_{group}	F_{cov}	P_{cov}	PI vs S	PI vs C	C vs S
PSQI with SAS	50.96	<0.0001	0.24	<0.63	PI → S, $P < 0.001$	PI → C, $P < 0.0001$	S → C, $P < 0.0001$
PSQI with BDI	35.41	<0.0001	0.11	<0.75	PI → S, $P < 0.003$	PI → C, $P < 0.0001$	S → C, $P < 0.0001$
PSQI with MCQ-I	15.68	<0.0001	2.98	<0.09	NS, $P < 0.23$	PI → C, $P < 0.001$	S → C, $P < 0.001$

PSQI, Pittsburgh Sleep Quality Index; SAS, Self-rating Anxiety Scale; BDI, Beck Depression Inventory; MCQ-I, Metacognitions Questionnaire – Insomnia; ANCOVA, analysis of covariance; PI, primary insomnia patients; S, snorers; C, healthy controls; NS, non-significant.
F-values and significance of both group-effect and covariate are shown for each ANCOVA. For each ANCOVA, the significance of each pairwise comparison is shown, along with the direction of the comparison. *P*-values <0.0001 are saturated to 0.0001 for visualization purposes. ANCOVA were performed on rank-transformed scores.

is the Wells Self-Regulatory Executive Function [34–36]. As proposed by Waine et al. [23] on the basis of Wells's S-REF, the perpetuation of PI in a sleep-disturbed individual once awakened during bedtime is triggered by intrusive thoughts concerning his/her own sleep and other sleep-related cognitive activities.

One limitation to the study may lie in the difference in age distribution between the three groups (53 ± 3, 54 ± 3 and 50 ± 5 years for PI, snorers and healthy controls, respectively; Table 1); however, this difference was not statistically significant as verified by the ANOVA on age with group as between-factor ($F_{group} = 0.46$, $P = 0.63$).

It is important to point out that the present study does not permit assessment of directionality and causation between metacognitive beliefs and PI. Further studies are needed to assess the psychological nature of metacognition in PI – for example, do metacognitive beliefs represent a trait factor preceding insomnia or a state factor triggering and maintaining insomnia?

In conclusion, this study indicates that metacognitive beliefs are eligible for being considered fundamental in the etiology and/or maintenance of PI. From a preclinical standpoint, we suggest that the early assessment of metacognition may help in identifying individuals more prone to the development of PI. In the case of

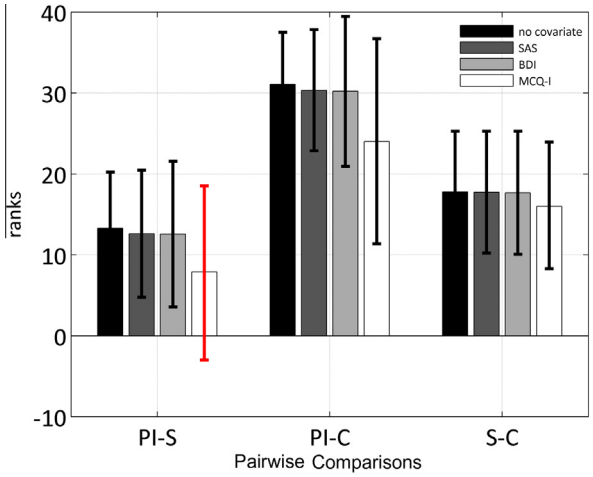

Fig. 2. Pairwise comparison for Pittsburgh Sleep Quality Index (PSQI) submitted to analysis of variance (black bars), analysis of covariance (ANCOVA) with Self-rating Anxiety State (SAS; dark grey bars), ANCOVA with Beck Depression Inventory (BDI; light grey bars), and ANCOVA with Metacognitions Questionnaire – Insomnia (MCQ-I; white bars) are presented. The first group of bars refers to the comparison between PI patients and snorers, the second to the comparison between PI patients and healthy controls, and the third group to the comparison between snorers and healthy controls. Each bar represents the mean value of the difference between two groups. Error bars denote the 95% confidence interval on the mean difference. Note that the only non-significant comparison, denoted by a red error bar, is obtained performing the ANCOVA on PSQI with MCQ-I as covariate.

established PI, a tailored psychotherapy approach targeting meta-cognitive beliefs may be a fruitful avenue to improve treatment outcomes.

If further studies confirm the promising findings herein described, the development of specific metacognitive models of PI [22] may help in understanding the development and maintenance of chronic poor sleep.

Funding sources

None.

Conflict of interest

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: http://dx.doi.org/10.1016/j.sleep.2014.03.017.

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